DOCUMENT RESUME

ED 338 289 JC 910 507

AUTHOR Wambold, Suzanne
TITLE Curriculum Needs Assessment in the Field of Cardiovascular Technology.
PUB DATE Dec 91
NOTE 76p.; M.Ed. Project, University of Toledo.
PUB TYPE Dissertations/Theses - Undetermined (040) -- Tests/Evaluation Instruments (160)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Allied Health Occupations Education; Community Colleges; Education Work Relationship; *Employer Attitudes; Employment Patterns; Graduate Surveys; Literature Reviews; Outcomes of Education; *Participant Satisfaction; Program Evaluation; Questionnaires; *Student Attitudes; Two Year Colleges
IDENTIFIERS *Cardiovascular Technology

ABSTRACT

In 1991, a study was conducted of the Cardiovascular Technology program (CTP) at the University of Toledo, Community and Technical College (ComTech). The purpose of the study was to identify deficiencies in the cardiovascular course content that may have contributed to the failure rate among ComTech graduates who took the 1986 Cardiovascular Credentialing International (CCI) registry examination, and to provide a rationale to the college administration supporting the need for curriculum revisions. Three groups of subjects were included in the study: 7 students currently enrolled in the CTP; 10 cardiovascular department managers who may have hired a program graduate; and 68 alumni from 1986 to 1990. Major study findings included the following: (1) one of the major strengths of the CTP indicated by the 1990 alumni and student respondents was program advising; (2) over 80% of all responding alumni reported that they were employed primarily in direct patient care in a hospital setting and were at least moderately satisfied with their current jobs; (3) the majority of the 1986-89 respondents indicated that they were dissatisfied with the teaching effectiveness and expertise of the faculty in the CTP as well as in the general studies area; (4) alumni indicated that antiquated on-site laboratory equipment affected their ability to master the diagnostic testing skills as it differed from the state-of-the-art equipment utilized in the clinical setting; and (5) responding employers ranked the competency of the alumni more highly in social skills than in clinical testing skills. Appendixes provide the survey instruments and associated letters and comments. (JMC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED338289

Curriculum Needs Assessment in the Field of Cardiovascular Technology

by

Suzanne Wambold

A project
presented to The University of Toledo
as partial fulfillment of the
requirements for the degree of
Master of Education
in
Higher Education

Elizabeth M. Hall Jones
Advisor

Graduate School

JC 910 507

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
S. Wambold
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

University of Toledo
December 1991

BEST COPY AVAILABLE

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ACKNOWLEDGEMENT

I wish to acknowledge the support and encouragement of my family and friends during the research and writing of this project; namely my husband Robert, my children Kelli and Katie, and my friends Judy, Carol, Margaret and John.

I wish to thank Dr. Elizabeth Hawthorne, Department of Educational Leadership, Program in Higher Education, The University of Toledo for her advice and assistance during the designing and writing of this project.

Table of Contents

Acknowledgements ii
Table of Contents iii
List of Figures iv
List of Tables v
Introduction 1
- Statement of the Problem 1
- Purpose of the Study 3
- Definition of Terms 3

Literature Review 6
- Implications for Educational Practice 10
- Summary 11

Methods 12
- Setting 12
- Subjects 12
- Objectives 13
- Research Design 13
- Instrumentation 14
- Response History 14
- Limitations 14

Findings 15
- Academic Program Assessment - Major Field of Study 15
- Academic Program Assessment - General Studies 17
- Alumni Information 20
- Career Related Activities 22
- Program Effectiveness Data 23
- Employment Changes 26
- Hiring Information 26
- Estimated Job Openings 27

Discussion 27
Conclusion 30
Appendices 33
- Appendix A Student Questionnaire 34
- Appendix B Alumni Questionnaire 42
- Appendix C Employer Questionnaire 53
- Appendix D Second Appeal Letter 60
- Appendix E Comments 62
- Appendix F Program Effectiveness Areas of Competence 64

References 67

List of Figures

Figure 1 Major Field of Study Responses 16
Figure 2 General Studies Responses 18

List of Tables

Table #1 Background Information 21
Table #2 Career Related Activities 23
Table #3 Employment Data 26

The University of Toledo

Toledo, Ohio 43606

University Office of Research
(419) 537-2844

April 11, 1991

TO: Professor Suzanne Wambold

RE: Research Project = 9165 Curriculum Needs Assessment of the Cardiovascular Technology Program at ComTech.

The University of Toledo Human Subjects Research Review Committee has completed its review of your research project utilizing human subjects.

Your project has been approved as submitted, and you are authorized to use human subjects in that project until 4/11/92. At the end of that that time, if your project is not complete, you must submit a request for an extension and a progress report in order to continue the project beyond that date. When your project has been completed, please fill out and send me the enclosed Certificate of Compliance.

This approval for the use of human subjects is contingent upon your following the research plan presented in your submitted proposal. You are not permitted to undertake any actions involving human subjects which are not a specific part of that proposal. If it becomes necessary to make changes, you may use those modifications only after you submit them for review and inclusion in your project file. Without such review, this authorization is void and you are not permitted to use human subjects in your research.

If any untoward incidents or unanticipated adverse reactions should develop in the course of your research on human subjects, you must suspend the project temporarily and notify me immediately.

Thank you very much for your cooperation. If you have questions, please feel free to contact me at 537-2418.

Gerald P. Sherman

Gerald P. Sherman, Ph.D., Chairman
Human Subjects Research Review Committee

cc: Office of Research
HSRC File

INTRODUCTION

STATEMENT OF THE PROBLEM

Educators throughout the fields of Allied Health are concerned with course content in their programs of study. How well prepared graduates are for employment is one of the driving forces behind curriculum assessment and revision. Course content needs to change to meet the demands of advancing medical technology (Andrew, 1972). To meet the needs of changing technology, educators must involve and rely on sources outside the educational setting, such as advisory committees and program alumni. These sources help in the development and revision of the curriculum to meet the needs of the student, the employer, the academic institution and society (Bowman, 1985, Diamond, 1989). This study analyzes the process of curriculum revision of one such Allied Health technical program, the Cardiovascular Technology program of the University of Toledo, Community and Technical College (ComTech).

The Cardiovascular Technology program is housed within the department of Health and Human Services, which is in the Community and Technical College of The University of Toledo. The Community College is one of seven colleges which make up the University of Toledo. The Cardiovascular Technology program has been in existence since 1982, and has graduated over 150 technologists. These graduates are employed in a variety of health care settings and perform a variety of noninvasive diagnostic examinations.

Graduates receive an Associate Degree in Applied Science with a major in Cardiovascular Technology. This competency-based program is designed to educate the student to perform and interpret 12-lead electrocardiograms (EKG's), cardiac stress test (GXT's), ambulatory monitoring (Holter) and cardiac ultrasound (Echocardiogram). The echocardiographic exam involves imaging (picturing) the heart as a two dimensional structure with Doppler and Color Flow imaging combined. The cardiovascular program includes didactic, laboratory and clinical assignments which center on the anatomy and pathophysiology of the cardiovascular system. During the students' clinical rotation they perform diagnostic procedures on patients, while being supervised by their clinical preceptor.

Upon completion of their degree requirements, these students are eligible for their national credentialing examinations through Cardiovascular Credentialing International (CCI) and after one year of job experience they are eligible for national credentials through the Society of Diagnostic Medical Sonographers (SDMS). Successful completion of these examinations is considered the ultimate standard for cardiovascular technologists. Therefore, state of the art course content must be implemented so students acquire the basic skills and knowledge needed to place them into the work force.

The field of cardiovascular technology is a rapidly expanding area of Allied Health. The mid 1980's were a time of rapid advancement in cardiac procedures. No longer were physicians limited to invasive examinations for diagnosing their patients. They were then able to utilize technologists to perform cardiac ultrasound, a noninvasive exam to assist in the diagnosis of heart disease.

Dramatic changes in the role of the cardiovascular technologists as diagnosticians mandated a thorough revision of the previous curriculum as students needed to be trained in the latest technology. Some reasons for advancement in cardiovascular ultrasound was a revision in computer technology which drives the ultrasound equipment and the public's awareness of their health status and available noninvasive medical examinations. Today, educators with the help of external and internal sources have identified particular high level skill areas that must be mastered to perform an adequate ultrasound examination. In light of the advances made in the 1980's the ComTech Cardiovascular Technology Advisory Committee members and program director began to appraise the curriculum. A major question regarding the Cardiovascular Allied Health program is the course content and student competency. Educators need to offer a program of study which prepares graduates with skills and knowledge required for successful completion of national registry exams as well as clinical competence for job placement.

In 1986 information was disseminated to all cardiovascular program coordinators and advisory committee members concerning the low pass rate of the 1986 CCI noninvasive registry examination. These results concerned the ComTech Cardiovascular Technology Advisory Committee. The results showed that in 1986, on their first attempt, only one of twelve ComTech graduates successfully completed the national registry examination in the area of cardiac ultrasound offered by CCI. Many members of the cardiovascular advisory committee are also local health care employers and only hire registered Allied Health

graduates. Therefore the program was not meeting the needs of the community that is was designed to serve.

A new program coordinator was selected for the fall quarter of 1989 as the former coordinator chose to seek employment in a critical care setting. The new program coordinator was chosen due to her combined clinical and educational skills.The teaming of these skills was seen as advantageous to fulfill the goal of assessing the cardiovascular curriculum and to assure that future alumni of the Cardiovascular Technology program at ComTech would possess the skills necessary for job entry level positions.

PURPOSE OF THE STUDY

The purpose of the study was two fold: to identify deficiencies in the cardiovascular course content that may have contributed to the failure rate among ComTech graduates who took the 1986 CCI registry examination and to provide a rationale to the College administration supporting the need for curriculum revisions.

DEFINITION OF TERMS

The following operational terms are used in the cardiovascular field and are unique to the practice of cardiovascular technologists:

Ambulatory Monitor (Holter): This is a noninvasive exam in which a tape recorder device is worn for a twenty-four hour period during which all heart beats are recorded. The tape is later scanned via a computer by the technician for abnormal rhythms and heart beats.

Behavioral Objective: An explicitly stated set of competencies to be mastered (written and or observed behavior) after a student has been instructed in the educational material.

Cardiovascular Technologists: This Allied Health professional performs the following noninvasive diagnostic tests: electrocardiograms, cardiac stress tests, ambulatory monitoring and cardiac ultrasound.

Cardiovascular Credentialing International (CCI): This is an independent, non-profit organization which administers registration examinations in diagnostic medical sonography (echocardiograms, peripheral vascular), invasive cardiovascular testing and certification examinations in the areas of electrocardiograms, stress testing, and ambulatory monitoring.

Cardiac Ultrasound (Echocardiogram, 2-D, Real time, Sonography): This is a noninvasive diagnostic examination, that images the heart and valves by the use of sound waves. The image is two-dimensional, such as a motion picture and is recorded on a video tape so it may be replayed and reviewed for interpretation by a physician.

Color Doppler Echocardiography: This is the presentation of a cardiac ultrasound exam with color Doppler shift information superimposed onto a black and white image of the heart. Blood flow patterns are recorded moving away or towards the ultrasound transducer by different colors on the display. Color Doppler is probably the method of choice for noninvasive evaluation of abnormally functioning valves.

Committee on Allied Health Education and Accreditation (CAHEA): This subcommittee of the American Medical Association provides essentials and guidelines for allied health programs. Accreditation may be granted to programs which meet the requirements.

Competency Based Education: An instructional systems approach to education that includes individualized instruction, mastery learning and criterion referenced measurement (Bloom, 1969).

Doppler Ultrasound: This is the presentation of a cardiac ultrasound exam with a frequency change of reflected sound wave as a result of moving blood cells. Blood flow patterns are recorded moving away or towards the ultrasound transducer and are recorded for interpretation. Continuous wave Doppler and Pulsed Doppler are

two available forms of Doppler and are both effective in detecting and semi-quantitatively evaluating abnormally functioning valves.

Electrocardiogram (EKG): This is a recording device which measures the electrical activity of the heart rate and rhythm. An EKG is a noninvasive exam.

Invasive Examination: An invasive examination involves the use of instruments that enter the body to perform a diagnostic exam. An example of an invasive exam is a cardiac catheterization in which a catheter is placed in the aorta and dye is injected directly into the coronary arteries.

Mastery learning: Written or observed behavior that is in compliance with pre set behavioral objectives and these behaviors are achieved within a fixed amount of time. Mastery learning is based upon objectives and in used throughout competency based education programs (Gagne, 1974).

M-Mode Echocardiography (ice pick): A method of cardiac ultrasound which images in one dimension, by depth. This is a noninvasive exam which records the motion of the heart and valves but it is not two-dimensional.

Noninvasive Exam: A noninvasive examination involves the use of instruments that do not enter the body while performing a diagnostic exam. An example of a noninvasive exam is a EKG or Echo.

Society of Diagnostic Medical Sonographers (SDMS): Recognized as a separate Allied Health Field by CAHEA, this organization helped develop the Essentials and Guidelines for CAHEA.

Stress test (GXT, CST): This is a noninvasive exam that measures the patient's heart rate and rhythm while riding a bike or walking on a treadmill.

Transducer: This instrument is a component of the ultrasound machine and is responsible for sending out and receiving sound waves which allow the machine to image the heart in two-dimensional and Doppler format.

Transesophageal Echocardiography (TEE): This exam involves ultrasonic access to the heart from the esophagus. Cross-sectional images of the heart are recorded from the esophagus with different orientations. This exam is a valuable method for intraoperative monitoring of myocardial ischemia and left ventricular function. It is also the exam of choice for assessing prosthetic valves and dissecting aneurysms.

LITERATURE REVIEW

The purpose of a literature review according to Woods (1988) is to analyze the literature and to identify the current and previous knowledge base of related studies. Although literature regarding curriculum design and evaluation abounds in many Allied Health technology fields, no research has been conducted on Cardiovascular Technology curriculum design and revision. Thus, the articles reviewed are about competency based education of nursing, respiratory and other Allied Health programs. In developing a competency based education program, the nursing and respiratory care programs utilized internal sources (faculty, students) and external sources (employers, alumni, advisory committee) to plan curriculum and make any necessary revisions. Most programs report incorporating both internal and external sources provides an effective way to identify and correct deficiencies (Ponza, 1976, Brandt, 1988 and Wallington, 1980).

Walker (1980) by identifying skills necessary for job entry level positions was able to develop, vocational programs as competency-based education. An essential component of all competency-based education programs is clearly defined behavioral objectives which need to be included in all course syllabi. Clearly defined behavioral objectives allow students to know what is expected of them for successful completion of the course. Behavioral objectives are also used to assess student mastery of the skill. Walker also discovered that certain prerequisite skills or basic skills are needed for all technical and occupational programs. Walker arranged the behavioral skills objectives in a hierarchical fashion demanding mastery of lower level objectives, before the higher level objectives could be attempted. An important component to his study was a strong emphasis on job entry competencies.

Bloom (1969) researched learning strategies for mastery based on the work of Carroll (1963), Morrison (1962), Skinner (1954), Suppes (1966), Goodlad and Anderson (1959)

and Glaser (1966). Bloom states mastery learning begins with the establishment of objectives (preconditions) so that mastery is defined and it will become apparent to the instructor and student when mastery of a specific skill has been achieved. Also, mastery learning may incorporate criterion referenced measurements in the form of objectives. The operating procedures (didactic component) may include either formative or summative evaluations or both, in the form of examinations. A student who has not mastered an objective or skill, may need alternative learning resources from the instructor. Alternative resources include rephrasing the information, retesting the individual or restructuring the instruction, all to meet the needs of the learner. Curriculum needs assessment leads to the identification of goals and objectives which assist the educator in the development of examinations and learning resources. Once the objectives and skills to be mastered are identified the educator can devise the testing mechanism to aid the student in mastering the objectives and skills.

The four major characteristics of mastery learning are : 1) systematic design of instruction, 2) appropriate instructional correctives, 3) sufficient time for learning and 4) clear criterion of mastery (Bloom, 1974). Based upon the characteristics of mastery learning and the concerns with the concept, program instructors who are aware of these weaknesses may find a means of strengthening their mastery learning theory.

Cox and Dunn (1979) reviewed the previous research of Bloom (1976), Carroll (1963) and Gagne (1974) in the area of mastery learning. There are two concerns that must be considered for those educators using the mastery learning model. First, mastery learning often falls short of its expectations because of failure to realize that all individuals are not equal in terms of abilities and prerequisites. Second, there are problems with the measurement in mastery learning, in terms of actual achievement, the rate of learning and the quality of instruction (Carroll, 1974).

Brady (1986) reviewed models used in theoretical orientations to curriculum planning. Brady noted that the objective model is preferred by most teachers and is most often used for curriculum planning. In the objective model the teacher is able to write the objectives in behavioral form, plan the appropriate teaching-learning method, and plan for evaluation. These objectives need to be presented to all students at the onset of a learning experience. If this learning experience is taking place in a classroom the student should receive a syllabus listing the objectives for the course.

Articles and studies concerning curriculum design and development are only one step in assessing curriculum effectiveness. After the program of study has been justified and is in place, the faculty must next perform an assessment of the objectives. Therefore articles and studies pertinent to the steps involved in a curriculum assessment are indicated.

Knox (1977) developed a needs assessment approach to assist the educator in identifying the educational needs of a selected course or program. Knox's model assumes a "gap" exists between the current curriculum and an "ideal" curriculum. A "gap" indicates that not all of the students will be able to achieve their objectives and skills in the time allowed in their program of study. An "ideal" curriculum is a program of study that allows the student time to achieve their objectives and become proficient in competency based skills, and due to their competence and achievements, successfully complete their credentialing examination. Essentially Knox's need-assessment approach is designed to identify any "gaps" in knowledge, competence, and commitment of any curriculum and provide data for revisions. A needs assessment is a critical component in justifying new course content or revising content of established courses. Thus, it may be used by many disciplines to assess their course content and student outcomes.

Knox (1977) outlines four-steps for a curriculum needs assessment. The process includes defining, collecting, analyzing and utilizing information about a specific course or program of study. When defining the target population in an academic setting, one considers the student. The second step is collecting discipline-specific data from the students and from "experts" (employers, alumni, advisory committee members) in the relevant content area. The third step of the assessment is to analyze the data for statistical significance. A comparison of the actual and perceived needs can assist in the development of curricula that is relevant to the field of study. Due to the rapid changes in the Allied Health field, it is imperative that the educator analyze the data to reflect current learning needs of the students and current emerging trends on a recurring basis. Accurate information of sufficient detail must be secured to validate any course revisions. The fourth step utilizes the collected data which is used to prioritize and select those needs which through systematic analysis have been identified as most important.

Patton (1980) examined employers' concerns regarding competencies in a curriculum needs-assessment. The following five needs were identified as deficiencies:

1) a need to reduce course development time without affecting quality (decrease time, increase quality)

2) a need for more effective use of subject matter experts (qualified educators)
3) a need to identify ways to assist the adult learner in adapting to the academic environment and then the work environment
4) a need to develop techniques in management training (offer training programs to the educators)
5) a need for research into the differences among the ways adults learn (educate educators on different teaching strategies based upon the student population).

With these points to consider, the underlying concern of skill training and competency-based assessment are cost, development time, and feedback utilization. It is suggested that private and academic educators work together to coordinate the realization of these goals.

Bowman (1985) stressed the performance discrepancies and organizational problems related to adult education programs, nursing in particular. Competencies the employer expects of the staff may vary from the perceived needs of the learner. Although it is important for educators to know the perceived needs of the learner; the employer is more often concerned about accreditation requirements and the expectations of the consumer, specifically the patient. Bowman's study identified assessment as an ongoing process in program development. The staff and employer, once identifying each other's needs, would then develop a working relationship so the staff would participate in the legal requirements (accreditation guidelines) of the institution and the institution would meet the needs of society (consumer, patient).

Salvia and Hughes (1990) in their text Curriculum Based Assessment: Testing What is Taught, specify the reasons for assessment, and approaches to analyzing the curriculum, formulating objectives, developing assessment procedures, collecting data, summarizing data, designing tables and graphs, and interpreting data. The section on a model for curriculum based assessment discusses the prerequisites the learners bring with them into the classroom and how it is important to provide the students with a progress evaluation. Cox and Dunn (1979) and Salvia and Hughes (1990) all emphasized the importance of prerequisite knowledge of students. Salvias' and Hughes' model is a step by step approach beginning with the decision to use a formative or summative evaluation. An analysis of the curriculum is completed with formulation of behavioral objectives. Development of appropriate assessment procedures and collection of data then lead to the interpretation of the data from which any decisions to redesign the curriculum will be made. This text indicates the importance of the learner and their prerequisite knowledge along with the necessity of structure and evaluation in any academic institution.

Diamond (1989) describes an alternate systematic approach for analyzing curricula and course content as well as ways to gather data and evaluate any course or program. Case studies are included and help explain the teaching and learning impact on the students in the classroom. The importance of input from internal and external sources, the students and the employers is very necessary to develop an ideal curriculum. His model is not restricted to objectives, or quantifiable data.

Diamond (1989) and Knox (1977) suggest all programs and courses whether old or new should undergo periodic review for appropriate course content. Maintaining course content at the state of the art level in the Allied Health field helps structure an ideal curriculum which is the ultimate goal of all education programs.

IMPLICATIONS FOR EDUCATIONAL PRACTICE

In the 1950's the clinical application of ultrasound technology was primarily limited by the capabilities of the ultrasound equipment. Technologists gained educational experiences by visiting laboratories whose staff specialized in understanding this new technology. The early 1960's and 1970's found ultrasound manufacturing companies hiring and training technologists to become "Field Application Specialists" with the responsibility of training potential consumers (physicians and technologists) the clinical usefulness of ultrasound applications. By the mid 1970's, ultrasound became well known and various medical residency programs included the application, technique and limitations of ultrasound in their cardiac clinical rotation.

In this development period it was realized by physicians and technologists that dedicated programs with established guidelines were needed to bring consistency into training programs. Due to this need the American Institute of Ultrasound in Medicine (AIUM) and the Society of Diagnostic Medical Sonographers developed guidelines to reflect the changing nature of the field. In conjunction with established guidelines SDMS along with CCI offer credentials to technologists who successfully complete their exams.

Another significant development in ultrasound was the recognition of the Cardiovascular Technologist by CAHEA. This meant that two Allied Health Tracts could educate a student

to become a CVT with a specialty in invasive, non-invasive, cardiac or peripheral vascular Doppler techniques or a DMS with an echocardiography background.

Although CAHEA offers these two tracts for program accreditation, by complying with the essentials and guidelines, CAHEA does not develop behavioral objectives, but allows each institution to design and implement their own. To accomplish mastery of all ultrasound tasks, it is important that each student has demonstrated assessment qualities and technical skills in the laboratory setting prior to attempting and demonstrating them on patients in the clinical setting. Students in any Allied Health field must demonstrate competency in all mandatory skills, as indicated by their course objectives, which have been established by external and internal sources in a needs-assessment approach.

The Committee on Allied Health Education and Accreditation (CAHEA); a Subcommittee of the American Medical Association (1977), is one resource for assessing curriculum content, by performing a self study to see how a program compares to the guidelines and essentials prepared by CAHEA for program accreditation. CAHEA, however does not stipulate in the essentials how many classroom hours or clinical examinations are to be completed to demonstrate competence or mastery of a ultrasound skill. As of 1991, CAHEA has only accredited four academic programs in the area of noninvasive Cardiovascular Technology.

SUMMARY

Throughout the program of study, educators should provide goals, behavioral objectives, learning activities and course descriptions to all students for all courses. Inherent in this provision is the exact method that will be used in the evaluation of their laboratory and clinical performance. The primary institutional method of choice to assure that a program meets the needs of the student, the employer, the academic setting and society is to utilize a needs assessment tool. Contributions to this assessment from the internal and external sources will aid in developing and implementing course content that is consistent with state of the art instruction. This combined effort and method contributes to a competency-based curriculum.

In the field of curriculum design and evaluation, the literature review models of Knox (1977), Walker (1980), Brady (1986) and Diamond (1989) all relate to informing the students of what expectations are to be met. The need for input regarding curriculum from internal and external sources is essential. To obtain this essential information, this study utilized three survey instruments, one for students, one for alumni and one for local health care employers. See appendices 1, 2, and 3 for survey instruments.

METHODS

The setting, subjects, objectives, research design, instrumentation, procedure for data collection and response history used in this study are identified below.

SETTING

The setting for this study is The University of Toledo Community and Technical College which offers an Associate Degree in Applied Science with a major in Cardiovascular Technology.

SUBJECTS

Three groups of subjects were included in the study. The first group was comprised of the seven currently enrolled students in the Cardiovascular Technology Program. The second group was comprised of ten local cardiovascular department managers who may have hired a 1986-1990 graduate. Each health care institution participating in this study has an employee who is a member of the ComTech Cardiovascular Advisory Committee. The third group was comprised of sixty-eight alumni from 1986 to 1990. The alumni were divided into two groups of graduates from 1986 to 1989 and those who graduated in 1990. This division of responses was necessary due to these alumni completing their Associate Degree in Cardiovascular Technology under the direction of two different program coordinators.

OBJECTIVES

This study had the following four objectives:

1. To assess student and alumni perspectives of the strengths and weaknesses of their academic program in their major field of study and general education area.

2. To assess alumni ranking of how frequently specific echocardiography skills were required on the job and how well prepared the alumni believe they were to perform these skills on the job.

3. To assess employer evaluation of how frequently specific echo skills are required on the job and how well prepared the ComTech cardiovascular graduates were to perform these skills.

4. To record background data from alumni and employers for use in follow-up studies. These data consisted of current employment, benefits with employment, professional organization involvement, credentials and overall cardiovascular program satisfaction.

RESEARCH DESIGN

An experimental curriculum needs assessment survey designed specifically for the Cardiovascular Technology program at ComTech was utilized for this research . Diamond (1989) indicated the importance of input from the students, alumni and experts in the field of study when attempting to revise curriculum. The current students were considered the internal resources and the alumni and employers were the external resources. Thus these three groups were sought for responses. According to Knox's (1977) needs assessment model this study would collect discipline specific data from alumni and employers and after analysis would prioritize curriculum needs and provide recommendations to College administration to aid the educators in providing quality instruction to the target population which is the student population. Identification of any skills necessary for job entry level positions identified by the alumni and employers would assist the educator in offering a competency-based education (Walker, 1980).

INSTRUMENTATION

Approval was sought and granted by the Human Subjects Research Committee, The University of Toledo. See Appendix A for the student questionnaire; see Appendix B for the alumni questionnaire, and the employer survey is in Appendix C.

Two weeks following the original letter and survey a second letter and survey were mailed to all non-respondents. See Appendix D for the second appeal letter. Telephone requests were made to local health care employers who failed to respond to the second mailing.

RESPONSE HISTORY

The surveys were returned from seven students for a return rate of 100%, from twenty seven alumni from 1986-1989 for a return rate of 45%, from six alumni from 1990 for a 67% return rate and from seven local health care employers for a 47% return rate. Of the sixty-nine alumni surveys mailed, 33% were returned due to no forwarding address.

LIMITATIONS

One limitation was the low response rate from the 1986-1989 alumni and employers. However there did not seem to be any bias shown in the completed returns. It would have been helpful to secure the addresses and employers of all alumni to improve the response rate. There is no active alumni association for the cardiovascular technologists, a situation that hinders maintaining updated mailing lists. Also, the telephone requests to the employers found that several employers did not respond to the survey since they were relatively new to their position as director of the cardiovascular department and stated that they were hesitant to respond.

When ranking the graduates' preparedness for testing modalities as requested in the Program Effectiveness section of the questionnaire, the employers should have been asked to indicate preparedness by the employee's year of graduation. Though this seems like an easy request, it may be difficult to recall an employees job preparedness from 1986. The employers are better at responding to how their employees are currently functioning and

keeping pace with today's technology. Also with the turnover of department directors, the current director may not have hired the current employees and, therefore not be qualified to answer these categories. This argues for more frequent collection points.

Of the categories listed as testing modalities, Transesophageal Echocardiography (TEE) should have been included. This form of echocardiographic testing has received recognition by medical practitioners and is being performed is many institutions. It would have been helpful to identify how many institutions are performing this exam to justify adding it to the Cardiovascular curriculum.

FINDINGS

A series of analyses were performed on the data obtained to describe the sample and to determine if the objectives were met. The subjects are identified as students, 1986-1989 alumni, 1990 alumni and employers.

ACADEMIC PROGRAM ASSESSMENT - MAJOR FIELD OF STUDY

The seven current students and alumni of 1986 to 1990 were asked to rank their academic program by major field of study and non-major or general education course work. The major field of study program had seventeen components which included: program flexibility in meeting their individual needs (#1), pursuing their individual interests (#2), advising (#3), library resources (#4), learning resources (#5), facility (#6), on site laboratory (#7), off site laboratory (#8), clinical instruction (#9), participation in decisions affecting the program (#10), participation in course evaluations (#11), faculty teaching effectiveness (#12), faculty expertise in the classroom (#13), faculty expertise in the on site lab (#14), faculty expertise in the off site lab (#15), faculty commitment to students (#16), and time of courses offered (#17). Any category that received an overall rating of less than "good" was considered to be unacceptable and interpreted as a weakness in the cardiovascular program.

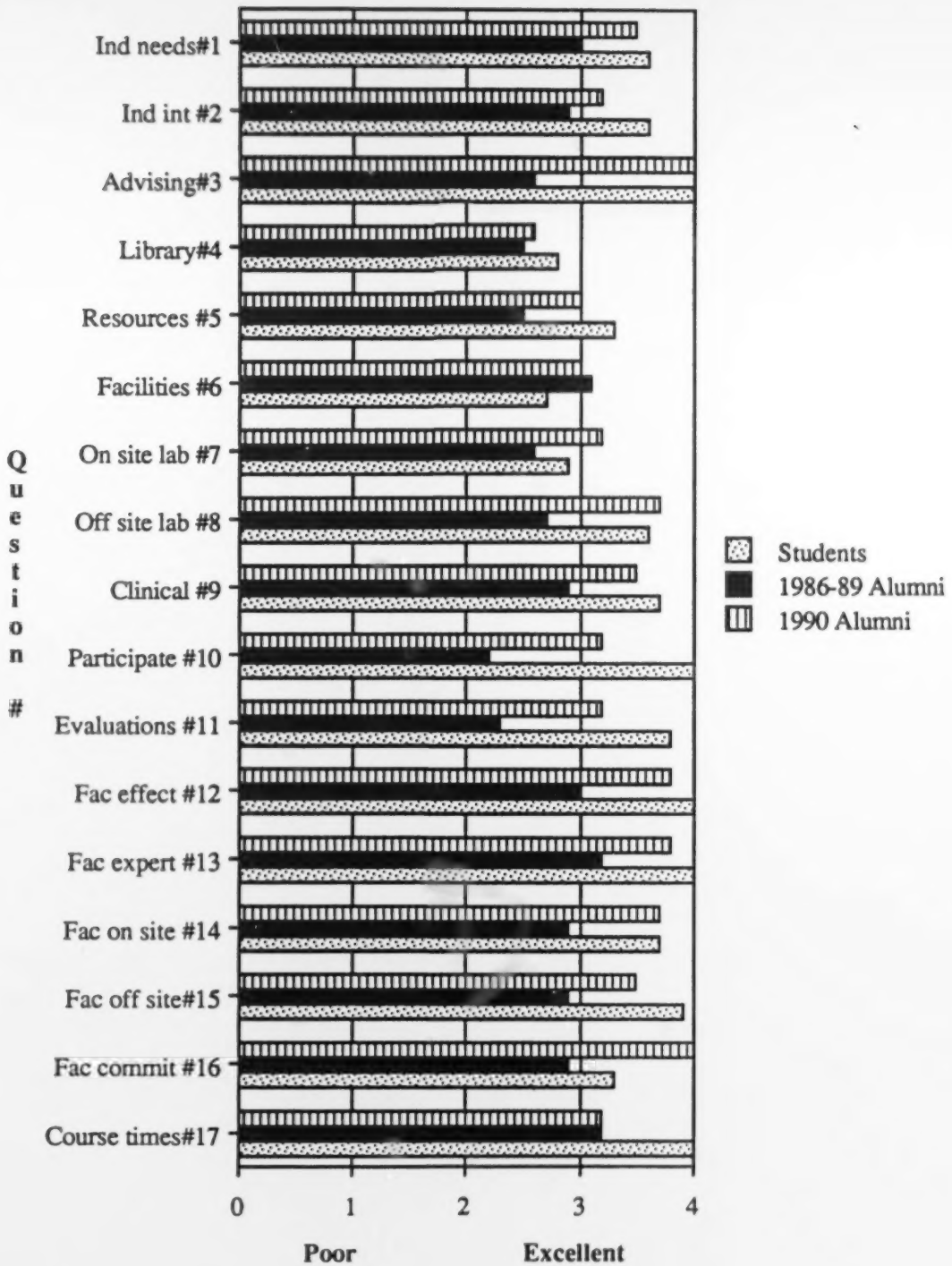

Figure 1
Major Field of Study Assessment

As can be seen in Figure 1, the 1986-1989 alumni indicated program weaknesses in twelve of seventeen categories of the major course work. This group identified weaknesses in all areas except: meeting their individual needs (#1), physical facilities (#6), faculty teaching effectiveness (#12), faculty expertise in the classroom (#13), and time of courses offered (#17). A weakness cited by all three groups was the library resources (#4). The students and 1986-1989 alumni agreed that the facilities and on site labs were inadequate.

According to these data, many of the weaknesses in the Cardiovascular Technology program have been corrected. The continuing problem areas are 1)the library resources which are deficient in cardiovascular journals 2) the facilities and 3) the on site laboratory. The equipment in the ComTech lab has consistently been viewed as outdated due to the rapid advancements in ultrasound equipment and the limited financial support for capitol equipment at ComTech.

The major strengths of the Cardiovascular Technology program indicated by the 1990 alumni and student respondents were: program advising (#3), opportunities for student participation (#10), teaching effectiveness (#12) and teaching expertise (#13). The strengths and weaknesses over time show the positive direction the Cardiovascular Technology program is taking.

ACADEMIC PROGRAM ASSESSMENT - GENERAL STUDIES

The students and alumni were also asked to respond to the program components of their non-major or general studies course work which consisted of fourteen categories: program flexibility in meeting their individual needs (#1), pursuing their individual interests (#2), advising (#3), library resources (#4), learning resources (#5), facility (#6),laboratory (#7), parking (#8), participation in course evaluations (#9), faculty teaching effectiveness (#10), faculty expertise in the classroom (#11), faculty commitment to students (#12), time of courses offered (#13), student services (#14). Any category that received an overall rating of less than "good" was considered to be unacceptable and regarded as an area in need of improvement in the general studies component of the cardiovascular program of study.

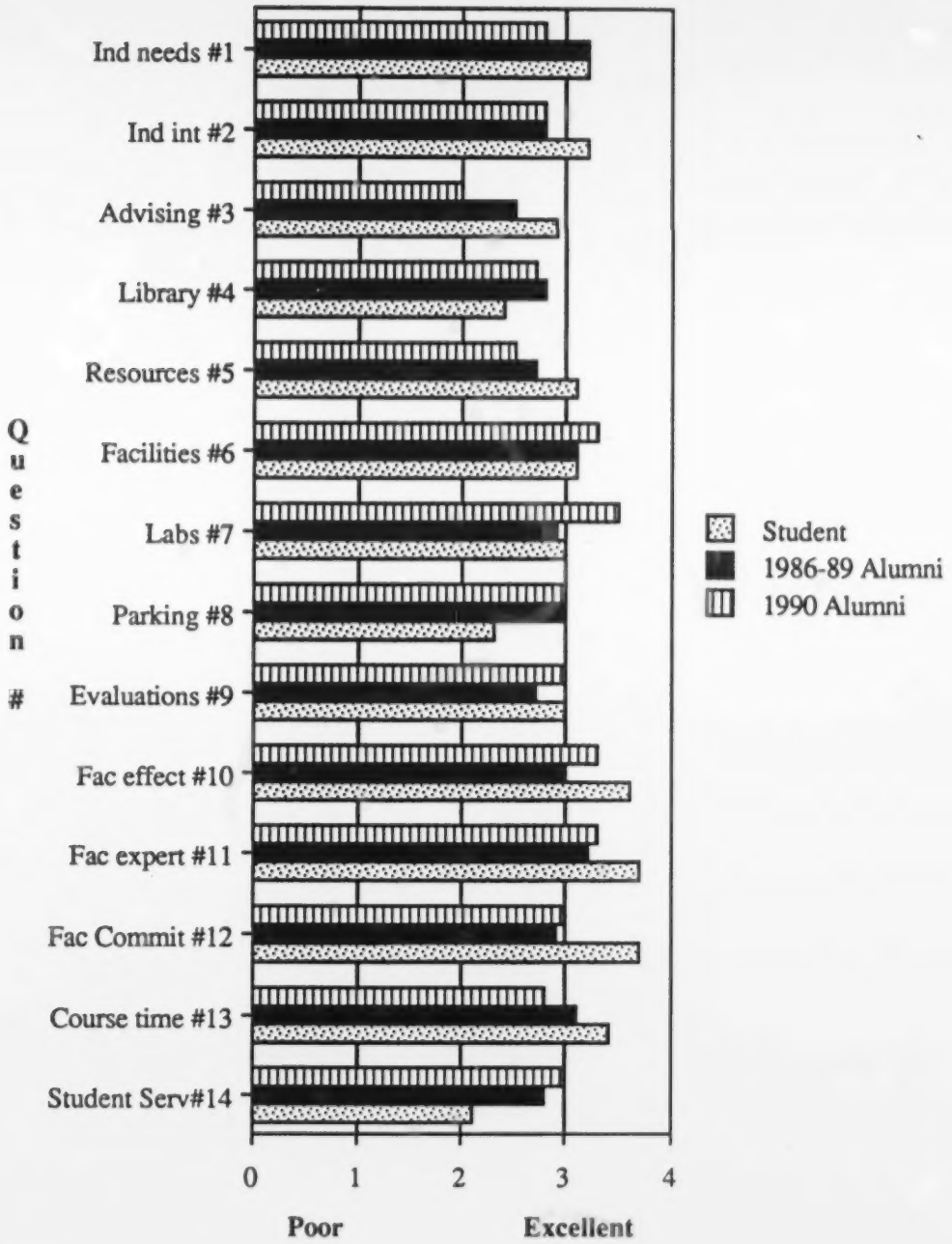

Figure 2
General Studies Assessment

As can be seen in Figure 2, once again the 1986-1989 alumni ranked more categories as unacceptable than the 1990 alumni or students. The 1986-1989 alumni indicated that the courses did not meet their individual interests (#2), or provide academic advising (#3) to their satisfaction. They also found a weakness in the library resources (#4), learning resources (#5), practice labs (#7), course evaluations (#9), teaching effectiveness (#10), faculty commitment (#12) and student services (#14). The 1990 alumni concurred in four areas; meeting their individual needs (#1), individual interests (#2), advising at the counselor level (#3), library resources (#4), learning resources (#5) and days and times of course offerings (#13). All three groups agreed that advising (#3) and library resources (#4) were not adequate. Library resources are a weakness in both the general studies area as well as the major courses.

The data from the general studies course work indicate that library resources, learning resources, individual interests, and individual needs must be addressed by the instructors offering support courses to the Cardiovascular program. One must keep in mind that the Associate Degree curriculum includes seventy credit hours of general studies at which time the student is exposed to a variety of courses and instructors which may give them the impression that the course did not meet their needs or interests. Though there are part time and full time instructors for these courses, each department should have a syllabus with objectives that all instructors should follow to verify that the same material is taught each quarter and that the students master the objectives listed in the syllabus. As indicated by Diamond (1989), all courses should undergo a periodic review to verify that the material is meeting the needs of the student and community.

Included in the returned questionnaires from both alumni groups were a variety of comments primarily relating to the clinical component of the Cardiovascular Technology program and the required physics course listed in the program of study. These comments were generated by nineteen of the twenty seven alumni and indicated that they were not satisfied with the Physics course that was required for the Cardiovascular Technology program. Some felt that the physics course was poorly organized and geared for Respiratory Care students more so than for the cardiovascular ultrasound students. The comments are listed in Appendix E.

ALUMNI INFORMATION

Alumni were asked about the following: year of graduation, education activities, employment status, work setting, primary role as an echocardiography technologist, current job position, and job satisfaction. Table 1 is a sample of the responses of this demographic information. Forty-eight percent responded to this component of the questionnaire.

As can be seen in Table 1, over 70% of the alumni continue to participate in educational events pertinent to the cardiovascular field by attending workshops and seminars that offer continuing education credit. Of the 22% of alumni pursuing a bachelor degree, three are attending The University of Toledo. The other alumni are attending universities out of state. This group of alumni was not as satisfied with the cardiovascular curriculum, and may have opted to return to school for a degree in nursing or health and human performance.

Over 80% of all responding alumni reported that they were employed primarily in direct patient care in a hospital setting and were at least moderately satisfied with their current employment. This would indicate that these alumni were doing the "hands on" component of the echo study. This would also account for the high percent of workers attending educational workshops. Echocardiography technologists working in the medical field need to stay current in their field of study, and in the echocardiography area there are rapid advances that the technologist must remain aware of. Since over 80% of alumni are utilizing their education in the area of direct patient care performing echocardiograms it is necessary for the upcoming students to be competent in performing the techniques and measurements mandatory for an echocardiography examination. Also with the direct care to patients, all students need to have good social skills to assist them in the work force.

Table 1
Background Information

Year of Graduation	1986-1989 # of Alumni	1990 # of Alumni
1986	7	
1987	6	
1988	7	
1989	7	
1990		6
Education Activities	**1986-1989 Alumni**	**1990 Alumni**
None	7%	17%
Working on a Bachelor's Degree	22%	
Attending Workshops	70%	83%
Employment	**1986-1989 Alumni**	**1990 Alumni**
Employed Full-time 40 hrs/wk.	62%	67%
Employed Part-time, less than 40 hrs/wk.	34%	17%
Employed as On-Call status	4%	17%
Work Setting	**1986-1989 Alumni**	**1990 Alumni**
Employed in a hospital	84%	80%
Employed in a physician office	8%	
Employed in a residential area	4%	
Employed by a mobile unit	4%	20%
Primary Role	**1986-1989 Alumni**	**1990 Alumni**
Direct patient care	92%	100%
Research	4%	
Teaching	4%	
Position	**1986-1989 Alumni**	**1990 Alumni**
Plan to change job within the next year	25%	20%
Change to increase responsibility	50%	100%
Change for personal reasons	33%	
Change for Full-time work	17%	
Job Satisfaction	**1986-1989 Alumni**	**1990 Alumni**
Very satisfied	34%	60%
Moderately satisfied	50%	40%
Neutral	12%	
Moderately dissatisfied	4%	

CAREER RELATED ACTIVITIES

All alumni responded to questions about career related activities. Table 2 is a composite of the respondents career related activities. Since 1986 only 40% of the graduates had become registered by Cardiovascular Credentialing International (CCI) or Registered Diagnostic Medical Sonographers (RDMS) in the field of noninvasive echocardiography and 42% reported no association with a professional organization. Of the alumni who did belong to professional organizations, 31% were members of CCI, 12% were members of American Society of Echocardiography (ASE) and 19% joined the National Society of Cardiovascular Technologists and National Society of Pulmonary Technologists (NSCT/NSPT). There is a concern that so few have joined a professional organization and that only 40% have successfully completed a national registry exam in the noninvasive field since 1986. The CCI registry exam is an option to all graduates of an Associate Degree program in Cardiovascular Technology. All students are encouraged to take this exam following graduation. The criteria for the RDMS exam is that the technologist has one year of full time echo experience prior to taking the exam. This exam is given in two parts, a noninvasive pathophysiology component and a ultrasound physics and instrumentation section. Successful completion in both sections is necessary to receive the registry credentials. Based upon some of the comments in Appendix E, the low percent of registered technologists appears to be due to the older alumni feeling unprepared overall.

Also in the background information component of the questionnaire, the alumni responded to their overall satisfaction with the cardiovascular curriculum at ComTech. Of the 1986-1990 alumni 52% were dissatisfied or rated program satisfaction as neutral. Some of the dissatisfaction of the program surfaced as comments that were returned with the questionnaire. Forty-eight percent of these alumni were satisfied with the program. Of the 1990 alumni 100% were satisfied with the program and had joined a professional organization. These alumni had access to a different laboratory structure and were under a different program coordinator. This satisfaction also became evident by their rating of their preparedness for their job in the Program Effectiveness section.

Table 2
Career Related Activities

Professional organization membership	1986-1989 Alumni	1990 Alumni
None	42%	
American Society of Echocardiography (ASE)	12%	17%
Cardiovascular Credentialing International (CCI)	19%	83%
National Society of Cardiovascular Technologists and National Society of Pulmonary Technologists (NSCT/NSPT)	23%	
Society of Vascular Technology (SVT)	4%	
Credentials	**1986-1989 Alumni**	**1990 Alumni**
Certified Cardiovascular Technician (CCT)	25%	83%
Certified Cardiovascular Technician(CCVT)	10%	17%
Registered Diagnostic Medical Sonographer (RDMS)	10%	
Registered Cardiovascular Technologist (RCT)	25%	
Registered Cardiovascular Technologist (RCVT)	30%	
Curriculum Satisfaction	**1986-1989 Alumni**	**1990 Alumni**
Very satisfied	15%	50%
Moderately satisfied	33%	50%
Neutral	30%	
Moderately dissatisfied	11%	
Very dissatisfied	11%	

PROGRAM EFFECTIVENESS DATA

The categories identified in this section of the questionnaire were based upon the current ComTech Cardiovascular Technology curriculum. Based on the results of the 1990 alumni, they are performing the majority of these ultrasound skills in the work place. Thus the technical skills rated as frequently used by the 1990 alumni should be given extra consideration when defining the course objectives so mastery of these skills are accomplished by all future alumni so they meet the job entry level competencies.

Both alumni groups and employers were asked how frequently forty-two areas if competence were used at their work sites. Appendix F has a listing of the forty-two competencies. Patient care, patient instruction, communication skills, following the institutions rules and regulations, collaboration, self values, human values and self directed learning skills were the professional practice skills and testing modalities consistently reported as frequently used by both alumni groups and the employers. The actual "hands on" technical skills of obtaining views and measurements were only rated as frequently used by the 1990 alumni, of which over 80% are working in hospital settings, and performing direct care. The 1990 alumni view their echocardiography positions as more technical oriented than their predecessors. This may be due to the rapid advancement in echocardiography technology.

All three groups reported that blood pressures, medication explanation, wall motion score indexing, congenital heart disease and research were never used or not often used. Obtaining blood pressures and explaining medications is a skill that is used by the technicians during cardiac stress testing not echocardiograms. Wall motion score indexing is fairly new to the field of Cardiovascular Technology and is currently used in large teaching and research institutions such as the Mayo Clinic. Often after there are enough data to support a new skill, all institutions will adopt it as a component of their routine examination. Currently this skill is not used in our area. Since only 4% of the alumni indicated that they worked in the research field of echocardiography, most would not have experience performing this skill.

Also, the technologists who work in large teaching and research institutions are those frequently exposed to pediatric echocardiography. Although there are few local institutions which specialize in pediatrics, the study of congenital heart defects are a part of the ComTech cardiovascular curriculum. The need to understand the congenital heart defects is important to any technologist dealing with heart defects. Not only may these defects be seen in children, sometimes they are not diagnosed until adulthood. Thus, the need to understand the changes in the cardiac structure are necessary. Also, as children with congenital heart defects grow into young adults they will be in need of follow up exams and the technologist should be familiar with the defect and surgical repair.

Next the employers and both alumni groups were asked how well prepared the ComTech graduate was for the forty-two areas of competence listed in Appendix F. Patient care,

patient instruction, blood pressure monitoring, collaboration skills and self values were the professional skills and testing modalities reported with an overall rating of good to excellent by all three groups indicating that the ComTech graduate was prepared for these skills. This grouping of skills is only a portion of the actual echo exam views and measurements which are necessary skills when applying for a job or when preparing for a registry exam. By not being prepared for all components of the diagnostic echocardiography exam it would be difficult to excel when interviewing for an echocardiography job.

The 1990 alumni indicated preparedness in all technical areas except color flow echo data, congenital heart disease and wall motion score indexing. Their lack of preparedness in these area is due in part to the lack of frequency of use of these skills and the lack of clinical support in these areas during their clinical rotation.

Color flow imaging is a difficult but necessary component to echocardiography. It is required on 80% of the exams done today. It is a task that requires multiple cases of "hands on" time to develop the technique needed for this exam. This reported category weakness could be resolved by an increase of clinical hours as suggested in the comments Appendix E.

The alumni indicated a weakness in their preparedness for diagnosing and understanding the surgical repairs of congenital heart disease. It is difficult for students to have access to pediatric congenital abnormalities during their clinical rotation. As mentioned, most babies and children with congenital heart defects are sent to larger teaching and research institutions which our students do not have access to as clinical sites. Thus any student having a desire to work in pediatrics would need to find a hospital willing to train them in this specialized field after graduation.

The ultrasound skills being utilized by the alumni in the work place varied among the groups of respondents. The older alumni and employers perceived a greater use and preparedness of the nontechnical skills such as communication and collaboration over the technical skills compared to the 1990 alumni. The cardiovascular curriculum contains a variety of diagnostic ultrasound testing skills. The skill of color flow imaging was viewed as an area of unpreparedness due to it being an advanced skill requiring more clinical time to perfect it. Some skills such as diagnosing congenital heart defects and wall motion score indexing were not ranked as areas of frequent use or competence due to the infrequent use of these skills in the local clinical settings.

EMPLOYMENT CHANGES

Employee information requested about employment changes from 1986 to the present demonstrated that all employees left voluntarily. Most of the technologists left for positions with increased responsibility. Though these technologists were seeking positions with increased responsibility, the alumni survey indicated that only six technologists were seeking a Bachelors degree. Currently there is no Bachelors degree specific for a cardiovascular technologist. A Bachelors degree is preferred but not required of most institutions when promoting a technologist to a management position. Until a specific degree is outlined in this technical field, most alumni would have no incentive to pursue an undergraduate degree.

Table 3
Employment Changes

	1986-1989		1990-present	
ComTech graduates ONLY	Full-time	Part-time	Full-time	Part-time
a. Left Voluntarily	9	15	2	7
1. Full time employment	2	2	1	0
2. Part time employment	0	3	1	1
3. Position with increases responsibility	3	6	0	3
4. Relocated for personal reasons	2	2	0	2
5. Is no longer employed	2	2	0	1
b. Left Involuntarily	0	0	0	0
1. Terminated due to financial constraints of the institution	0	0	0	0
2. Terminated for professional incompetence	0	0	0	0
3. Terminated for personal conduct	0	0	0	0

HIRING INFORMATION

Employers were asked to provide information about their employees that were hired from various academic institutions housing a Cardiovascular Technology program. All employers responding to the survey hired only ComTech graduates since 1986. Since the cardiovascular program is located in Toledo, Ohio, it seems appropriate for health care institutions to hire alumni that have graduated from a local academic institution. The next nearest institutions are Cuyahoga Community College in Cleveland and Mary Grove College in Detroit, Michigan.

The employers also provided a salary range for their cardiovascular technologists. Starting pay ranged from $8.50 to $10.00 per hour with the highest rate of pay being $12.75 per hour.

ESTIMATED JOB OPENINGS

On average, employers reported that they estimated two new positions for the coming two years. The majority of these positions were either part-time or on-call positions and were more likely due to expansion than to turnover in the first year but more to turnover in the second year. Although predicting future employment needs is at best an inexact science, one may conclude that each cardiovascular department hopes to have an increase in their diagnostic testing and will thus need to hire additional technologists. Also with the advances in diagnostic cardiovascular testing, the time mandated for each exam is becoming prolonged and a second technologist would be needed to help accomplish the tasks of a busy day. But with the cut backs instilled upon hospital administration, part-time positions are easier to justify since they do not involve fully paid health benefits. Many employees are seeking full time employment with matching benefits and may find a need to relocate after a year of experience in echocardiography.

DISCUSSION

This study was implemented using the theoretical framework provided by Walker (1980), Knox (1977) and Diamond (1989). A strength of this study was that the findings provided knowledge related to alumni and employers' experiences with job entry competencies that was not previously available since there had been no previous curriculum needs assessment done at ComTech in the cardiovascular area. The literature review did not reveal a curriculum needs assessment specific to a Cardiovascular Technology program; thus this study provides preliminary findings upon which more studies can be built.

In this study the 1986 to 1989 alumni indicated weaknesses in the cardiovascular courses, specifically in the program effectiveness portion which dealt with ultrasound testing competencies. The respondents perceived deficiencies with the on site and off site laboratory instruction, antiquated laboratory equipment, faculty teaching effectiveness, and

faculty expertise in the classroom, all of which may have led to their reported lack of competence in the technical skills and testing modalities. They reported that the academic advising, library facilities, resources and laboratory equipment were considered insufficient to meet the needs of their course work and that they were unprepared for the technical aspects of their work. However the alumni felt comfortable with the communication skills utilized in their jobs.

The alumni reported that the antiquated on site laboratory equipment affected their ability to master the diagnostic testing skills as it differed from the state-of-the-art equipment utilized in the clinical setting. Outdated on site lab equipment prevented the students from practicing their Doppler and color flow imaging skills. Lack of preparedness in the laboratory site hindered the students in their clinical rotation, which was a time to demonstrate on patients, under supervision, what they had learned in their classes and labs. When these students entered their clinical rotation, they were not allowed to demonstrate many of the necessary ultrasound testing skills due to their unpreparedness. Thus, they had a poor clinical experience. Therefore, surveyed alumni perceived themselves as insufficiently prepared for the technical aspects of their job.

In addition, their training in the areas of congenital heart defects and color flow imaging was perceived as deficient. Color flow imaging is a basic skill of cardiovascular technology and became a component of a routine exam in 1987. Although the alumni were introduced to this skill, they did not have access to state-of-the-art equipment until they attended their clinical rotation. Thus, this group of alumni reported that they did not feel competent using current technology.

Both alumni and employers expressed concern about the skills used to diagnose congenital heart defects. These groups did not see a direct benefit from this component since so few institutions specialize in pediatrics. Despite this criticism it is appropriate to have curriculum devoted to pediatric heart defects, due to the the growing number of children recovering from congenital heart defects.

Library resources were perceived as deficient as they lacked current subscriptions to professional journals. These resources, while available locally, were not conveniently located at the ComTech library. In 1990 the media center purchased twelve video tapes with case study methods of diagnosing cardiovascular pathology by cardiac ultrasound. These tapes are now available to the students in the library at ComTech.

This group of alumni also indicated problems with the physics course which is the basis of Doppler ultrasound and color flow imaging with which they must become competent during their course of study. Without the basic understanding of the underlying principles the noninvasive pathophysiology is very difficult to comprehend. The physics course was organized to meet the needs of two Allied Health programs in one class. This did not allow for comprehension of objectives specific to cardiac ultrasound and may in part account for comments submitted in Appendix E. Since the SDMS registry exam involves a physics and instrumentation component along with an echocardiogram component, lacking the knowledge of basic ultrasound physics and instrumentation would make passing the SDMS registry in the field of cardiovascular technology very difficult. Being unprepared after two years of education would lead to a low rate of registered alumni and the survey results indicated that only 40% of the ComTech alumni are registered in the field.

The majority of the 1986-1989 respondents indicated that they were dissatisfied with the teaching effectiveness and expertise of the faculty in the cardiovascular program as well in the general studies area. This group of alumni was attending courses as the technology was changing and the curriculum did not keep up with the needs of the students, employees, or community. Program coordinators of any Allied Health Program need to remain current with the technology they are implementing.

The findings of this study indicated that the 1986-1989 alumni felt unprepared for the job market. Factors cited that could have led to their unpreparedness were out dated laboratory equipment, insufficient clinical preparation, inadequate classroom preparation, insufficient resources, and lack of instructor effectiveness.

The 1990 alumni reported fewer weaknesses in their major field of study, general studies and area of program effectiveness than did the earlier group of alumni. They did indicate deficiencies in the library resources and on site laboratory equipment as did the 1986-1989 alumni. In the program effectiveness area, which included the ultrasound competency skills, these alumni indicated deficiencies in color flow imaging, wall motion score indexing and congenital heart defects. However, they reported feeling prepared for the remainder of the testing skills and communication skills.

The 1990 alumni had an advantage over the earlier alumni in that they were privileged to use clinical sites with state-of-the-art equipment including Doppler and color flow imaging.

Their weekly laboratory component allowed them time to practice and perform the "hands-on" skills of an echocardiography examination. Also these labs were staffed by registered technologists, who could reinforce both the pathology and technical areas of ultrasound. With the use of the state-of-the-art equipment and competency in advanced skills, the 1990 alumni reported that they felt prepared for the changing technology in which they were seeking a job and responded positively to these areas in the survey.

Even though the 1990 alumni attended their labs at clinical sites where color flow imaging is currently and routinely done, they reported that they also felt unprepared for performing this skill. This is expected due to the Doppler and mapping technology involved in mastering this skill, which requires additional "hands on" time. An updated ultrasound machine on campus would allow open lab time for the students to practice this skill. As a result of the findings, laboratory and clinical hours may be increased.

Based on the 1990 alumni survey reports, these graduates felt that overall they were prepared for entry level job placement and that they were comfortable with the current technology. Their reported competence in the ability to perform ultrasound skills could have resulted from a new program coordinator, and a change in laboratory sites and laboratory faculty which provided them with a pleasing clinical experience.

On the other hand, the employers responding to the questionnaire ranked the competency of the social skills of the alumni higher than the competency of their clinical testing skills, but the employers did not identify the employees' year of graduation in the study. Their results were a composite of alumni from 1986 to 1990. When hiring a technologist the employer needs someone trained in both social and technical skills. Thus, the current graduates should be better prepared for the work force.

CONCLUSION

The curriculum of the cardiovascular technologist is continuously influenced by advancements in diagnostic methods and treatment. Thus program flexibility is necessary to accommodate technological changes. Results of the survey of the ComTech Cardiovascular Technology program bring out the following points. There is a need to have frequent contact with the local health care employers so that new techniques are implemented into the

curriculum. Also, the alumni must be surveyed for their perception of their program of study and how it helped or hindered them from employment. Input into the curriculum by the alumni and employers should serve to strengthen the program.

A strength of the current program has been its use of clinical sites to practice laboratory skills and master the ultrasound competencies. The state-of-the-art equipment and laboratory staff are pluses for the students and should be maintained and continuously monitored.

The purchase of audiovisual resources for the program will help the students in referring to abnormal pathology which they may not see until their clinical rotation. A routine review of resource materials needs to be an ongoing process because of the rapid changes in the ultrasound field. Since 1990, most technical skills of the program are being mastered by the students, but the technical skills of color flow imaging and diagnosing congenital heart disease are still in need of improvement. Also, the on site laboratory equipment needs to be updated, and the physics course is in need of revision.

Based upon the results of this study and my observations of the program the following recommendations are made to the administration of ComTech and are intended to improve the Cardiovascular Technology program by including training that will increase student satisfaction and competence and match them to the needs of the work place.

1. Remedy the deficiencies in the library resources for the Cardiovascular Technology program and the general studies courses. Subscriptions to current journals such as American Society of Echocardiography and Vascular Technology should be addressed with the manager of the library.

2. Upgrade the laboratory equipment to reflect the currently used ultrasound testing skills. This upgrade should provide a secured laboratory area which is accessible to the students for practicing their technical skills. This equipment would also be used for classroom demonstrations. If capital equipment money is not readily available, a resource person may be provided to assist the program coordinator in writing a grant for funding of this equipment.

3. Revise the physics course. The Applied Medical Physics course currently required is not adequately preparing cardiovascular students. It is recommended that a Physics course be developed that deals specifically with the basic principles of propagation of sound, Doppler ultrasound, color flow Doppler, transducers and instrumentation. This preparation will assist the students in mastering the ultrasound skills and prepare them for their registry exam. It would be best to institute two consecutive ultrasound physics courses, so that the material is taught concurrently with the two cardiology courses.

4. Revise the curriculum to increase clinical hours and class time in the cardiology courses. An increase in clinical hours would provide the students with more "hands on" time to master their skills such as color flow imaging. To accomplish this, support courses which are beneficial although not essential may be changed to electives to expand the clinical component.

5. Allow the Program Coordinator to attend national conferences and seminars related to the field of cardiac ultrasound so that the upcoming diagnostic ultrasound testing skills are implemented into the cardiovascular curriculum in a timely manner.

6. The Cardiovascular Technology Program Coordinator should implement quarterly advisory committee meetings for ongoing assessment and revision of the program of study so it can serve the needs of the community, students and employers.

APPENDICES

APPENDIX A
STUDENT QUESTIONNAIRE

Dear Cardiovascular Technology Student

May 30, 1991

We are asking for the assistance of the University of Toledo Community and Technical College Cardiovascular Technology Program students.

As a part of our program evaluation, we are conducting a survey regarding the curriculum in the Cardiovascular Technology program. Please complete the following survey about the cardiovascular curriculum and your work status. The purpose of this survey is to learn about students views concerning the curriculum and preparation for registry examinations. Your responses will help us to improve the quality of the program. Therefore your answers and responses are invaluable to our program.

The information you provide for this survey will be used only for purposes of program planning and evaluation. All information is confidential and your identity will not be revealed. Data have been coded to verify returned surveys. A master list will be kept with the principle investigator, and it will be disposed of after the results are compiled.

Your participation is voluntary and will not affect your relations to the University of Toledo. A completed returned survey is considered consent to participate in the project.

Thank you in advance for your time and assistance. Please return the completed survey in the self-addressed, stamped envelope provided by June 15, 1991. If you have any questions about the survey, please phone me at 537-3112. I will be happy to discuss any concerns you may have.

Sincerely,

Sue Wambold, Director
Cardiovascular Technology

Part I - A: Program Evaluation

Directions: Please rate the overall assessment of the ComTech Cardiovascular Technology program in relation to each of the following program components using the following scale. Consider the **MAJOR** course work which included Cardiology I through Cardiology VI. Please comment regarding particular strengths and weaknesses of the program on the reverse side of this sheet.

In the column provided, indicate how well the ComTech Cardiovascular Technology program met your needs using the following scale.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

	Item	COLUMN
1.	Flexibility of program in meeting individual needs	
2.	Opportunities to pursue individual interests	
3.	Academic/career advising from the program director	
4.	Library resources	
5.	Learning resources: Practice labs, audiovisuals, computer assisted instruction	
6.	Physical facilities (eg. class rooms)	
7.	On site cardiovascular laboratory instruction	
8.	Off site cardiovascular laboratory instruction	
9.	Clinical facility instruction	
10.	Opportunities to participate in decisions affecting the program	
11.	Opportunities to evaluate cardiology courses	
12.	Faculty teaching effectiveness, in the classroom	
13.	Faculty expertise, in the classroom	
14.	Faculty expertise in the on site laboratory	
15.	Faculty expertise in the off site laboratory	
16.	Faculty commitment to students	
17.	Days and times courses offered	

Part I -B: Program Evaluation

Directions: Please rate the overall assessment of the ComTech Cardiovascular Technology program in relation to each of the following program components using the following scale. Consider **NON-MAJOR** course work. Please comment regarding particular strengths and weaknesses of these classes on the reverse side of this sheet.

In the column provided, indicate how well ComTech met your needs using the following scale.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

	Item	COLUMN
1.	Flexibility of program in meeting individual needs	
2.	Opportunities to pursue individual interests	
3.	Academic/career advising at the counselor level	
4.	Library resources	
5.	Learning resources: audiovisuals, computer assisted instruction	
6.	Physical facilities (eg. class rooms)	
7.	Practice laboratory	
8.	Parking facilities	
9.	Opportunities to evaluate courses	
10.	Faculty teaching effectiveness	
11.	Faculty expertise	
12.	Faculty commitment to students	
13.	Days and times courses offered	
14.	Student services (eg. registrar, financial aid, etc.)	

Part II: Background Information

1. When do you expect to graduate from ComTech with an Associate Degree in Applied Science, with a major in Cardiovascular Technology?

_____Year _____ Term

2. Are you currently employed in the cardiovascular field?
a. _____ Yes b. _____ No

If you <u>are not</u> currently employed in the cardiovascular field, you may continue with question #11.

If you <u>are</u> currently employed in the cardiovascular field, please continue with question #3.

3. Which of the following best describes your current employment status?

_____a. Employed, full-time Hours per week _____
_____b. Employed, part-time Hours per week _____
_____c. Contingency/On call Hours per month _____
_____d. Unemployed

4. Are there benefits with part time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

5. Are there benefits with full time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

6. What type of setting do you work in?

_____ a. Hospital
_____ b. Physicians Office
_____ c. Residential care facility
_____ d. Ambulatory carte center
_____ e. Community health agency
_____ f. Urgent care center
_____ g. Mobile unit

7. What is your primary role?

_____ a. Direct care
_____ b. Administrative/management
_____ c. Teaching
_____ d. Research

8. Do you hope to change positions within the next year?

_____ a. No
_____ b. Yes

9. If you do plan to change positions within the next year, please indicate why.

_____ a. Financial incentives
_____ b. Full time employment
_____ c. Part time employment
_____ d. To take a position with added responsibility
_____ e. Personal reasons

10. In general how satisfied are you with your present position?

_____ a. Very satisfied
_____ b. Moderately satisfied
_____ c. Neutral
_____ d. Moderately dissatisfied
_____ e. Very dissatisfied

CAREER RELATED ACTIVITIES

11. Do you belong to any professional organization? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. American Society of Echocardiography
_____ b. Cardiovascular Credentialing International
_____ c. NSCT/NSPT
_____ d. Other_____

12. Are you a credentialed cardiovascular technologist?

_____ a. Yes
_____ b. No

If "yes," in what year did you receive your credentials? _____

13. Which credentials do you currently have. (Check all that apply)

_____ a. CVT
_____ b. CCVT
_____ c. RDMS
_____ d. RCT
_____ e. RT
_____ f. CET
_____ g. CCT
_____ h. RCVT
_____ i. RN
_____ j. NSCT/NSPT
_____ k. RCPT

14. How satisfied were you with the ComTech cardiovascular curriculum in preparing you for the credentialing exam?

_____ a. Very satisfied
_____ b. Moderately satisfied
_____ c. Neutral
_____ d. Moderately dissatisfied
_____ e. Very dissatisfied

APPENDIX B
ALUMNI QUESTIONNAIRE

Dear Alumni

May 30, 1991

We are asking the assistance of the graduates of the University of Toledo Community and Technical College Cardiovascular Technology Program.

As a part of our program evaluation, we are conducting a long term follow-up of our alumni. Please complete the following survey about the cardiovascular curriculum and your work status. The purpose of this survey is to learn about alumni views concerning the curriculum and how it aided in their job placement and preparation for registry examinations. Your responses will help us to improve the quality of the program. Therefore your answers and responses are invaluable to our program.

The information you provide for this survey will be used only for purposes of program planning and evaluation. All information is confidential and your identity will not be revealed. Data have been coded to track the returned surveys. The survey should take no longer than 20 minutes to complete. A master list will be kept with the principle investigator, and it will be disposed of after the results are compiled.

Your participation is voluntary. A completed returned survey is considered consent to participate in the project.

Thank you in advance for your time and assistance. Please return the completed survey in the self-addressed, stamped envelope provided by June 15, 1991. If you have any questions about the survey, please phone me at 537-3112. I will be happy to discuss any concerns you may have.

Sincerely,

Sue Wambold, Director
Cardiovascular Technology

Survey of ComTech Cardiovascular Technology Alumni

Part I: Background Information

1. When did you graduate from ComTech with your Associate degree in Applied Science?
Year _____ Term _____

2. Since graduation have you participated in any continuing education activities?

_____ a. Enrolled in a Bachelor's program
_____ b. Plan to enroll in a Bachelor's program
_____ c. Taking courses not in a degree program
_____ d. Attend workshops and seminars
_____ e. No current activity or plans
_____ f. Other

If you are enrolled in a Bachelor's program, please complete the following table:

3a. Name of Institution _____

	Status	Major
3b.	Full time	
3c.	Part time	

4. Are you currently employed? a. _____ Yes b. _____ No

If you are currently employed, please continue with question #5

If you are not currently employed, please go to question #13

5. Which of the following best describes your current employment status?

_____a. Employed, full-time Hours per week _____
_____b. Employed, part-time Hours per week _____
_____c. Contingency/On call Hours per month _____
_____d. Unemployed

6. Are there benefits with part time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

7. Are there benefits with full time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

8. What type of setting do you work in?

_____ a. Hospital
_____ b. Physicians Office
_____ c. Residential care facility
_____ d. Ambulatory carte center
_____ e. Community health agency
_____ f. Urgent care center
_____ g. Mobile unit

9. What is your primary role?

_____ a. Direct care
_____ b. Administrative/management
_____ c. Teaching
_____ d. Research

10. Do you hope to change positions within the next year?

_____ a. No
_____ b. Yes

11. If you do plan to change positions within the next year, please indicate why.

_____ a. Financial incentives
_____ b. Full time employment
_____ c. Part time employment
_____ d. To take a position with added responsibility
_____ e. Personal reasons

12. In general how satisfied are you with your present position?

_____ a. Very satisfied
_____ b. Moderately satisfied
_____ c. Neutral
_____ d. Moderately dissatisfied
_____ e. Very dissatisfied

CAREER RELATED ACTIVITIES

13. Do you belong to any professional organization? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. American Society of Echocardiography
_____ b. Cardiovascular Credentialing International
_____ c. NSCT/NSPT
_____ d. Other_____

14. Are you a credentialed cardiovascular technologist?

_____ a. Yes

_____ b. No

If "'yes," in what year did you receive your credentials? _____

15. Which credentials do you currently have. (Check all that apply)

_____ a. CVT

_____ b. CCVT

_____ c. RDMS

_____ d. RCT

_____ e. RT

_____ f. CET

_____ g. CCT

_____ h. RCVT

_____ i. RN

_____ j. NSCT/NSPT

_____ k. RCPT

16. How satisfied were you with the ComTech cardiovascular curriculum in preparing you for the credentialing exam?

_____ a. Very satisfied

_____ b. Moderately satisfied

_____ c. Neutral

_____ d. Moderately dissatisfied

_____ e. Very dissatisfied

Part II - A: Program Evaluation

Directions: Please rate the overall assessment of the ComTech Cardiovascular Technology program in relation to each of the following program components using the following scale. Consider the **MAJOR** course work which included Cardiology I through Cardiology VI. Please comment regarding particular strengths and weaknesses of the program on the reverse side of this form.

In the column provided, indicate how well the ComTech Cardiovascular Technology program met your needs using the following scale.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

Item		COLUMN
1.	Flexibility of program in meeting individual needs	
2.	Opportunities to pursue individual interests	
3.	Academic/career advising from the program director	
4.	Library resources	
5.	Learning resources: Practice labs, audiovisuals, computer assisted instruction	
6.	Physical facilities (eg. class rooms)	
7.	On site cardiovascular laboratory instruction	
8.	Off site cardiovascular laboratory instruction	
9.	Clinical facility instruction	
10.	Opportunities to participate in decisions affecting the program	
11.	Opportunities to evaluate cardiology courses	
12.	Faculty teaching effectiveness, in the classroom	
13.	Faculty expertise, in the classroom	
14.	Faculty expertise in the on site laboratory	
15.	Faculty expertise in the off site laboratory	
16.	Faculty commitment to students	
17.	Days and times courses offered	

Part II -B: Program Evaluation

Directions: Please rate the overall assessment of the ComTech Cardiovascular Technology program in relation to each of the following program components using the following scale. Consider **NON-MAJOR** course work. Please comment regarding particular strengths and weaknesses of these classes on the reverse side of this form.

In the column provided, indicate how well ComTech met your needs using the following scale.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

Item		COLUMN
1.	Flexibility of program in meeting individual needs	
2.	Opportunities to pursue individual interests	
3.	Academic/career advising at the counselor level	
4.	Library resources	
5.	Learning resources: audiovisuals, computer assisted instruction	
6.	Physical facilities (eg. class rooms)	
7.	Practice laboratory	
8.	Parking facilities	
9.	Opportunities to evaluate courses	
10.	Faculty teaching effectiveness	
11.	Faculty expertise	
12.	Faculty commitment to students	
13.	Days and times courses offered	
14.	Student services (eg. registrar, financial aid, etc.)	

Part II: Program Effectiveness

Directions: Please rate the competency of the 1986-1991 graduates of the ComTech Cardiovascular Technology program in relation to each of the following professional practice skills and testing modalities using the following scale.

In **Column A:** In general how often does the ComTech cardiovascular technologist perform these tasks.

Scale: 1= Not at All 2=Not Often 3=Often 4=Very Often

In **Column B:** In general how well prepared are the ComTech cardiovascular technologists for these tasks.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

		COLUMN	
Item		**A**	**B**
1.	Basic physical principles of ultrasound and instrumentation		
2.	Proper use of gain and depth control		
3.	Proper transducer selection		
4.	Explanation of the principles of Doppler ultrasound		
5.	Techniques used in determining blood flow velocity profiles and characteristics (Bernoulli's equation, CW and PW)		
6.	Imaging of color flow mapping		
7.	Demonstrate an understanding of patient care		
8.	Explain and instruct procedures to patients		
9.	Obtain a blood pressure measurement prior to an echo		
10.	Explain the mechanism of action and indications for common cardiac medications		
11.	Perform an M-mode echo with structure measurements		
12.	Perform a two-dimensional echo with inspection of the heart from all views, and identification of the structures in each view		
13.	Accurately measure the fractional area change and fractional shortening		
14.	Accurately measure the mitral valve orifice area		

Item		A	B
15.	Compare the EKG infarct pattern with the wall motion abnormalities		
16.	Accurately calculate an ejection fraction		
17.	Perform pulsed wave doppler on all four cardiac valves		
18.	Perform continuous wave doppler on all four cardiac valves		
19.	Explain the fundamentals of color flow imaging for assessment of pathology		
20.	Assess valvular gradients with Doppler		
21.	Calculate the aortic valve area with use of CW and PW		
22.	Calculate pressure half-time of the mitral valve		
23.	Indicate pathology to be identified with diseases of the heart valves (insufficiency and stenosis)		
24.	Indicate the pathology to be identified with pericardial disease		
25.	Indicate the pathology to be identified with the cardiomyopathies		
26.	Explain wall motion score index in relationship to coronary artery disease		
27.	Explain the views utilized for assessment of congenital heart disease		
28.	Correlate history and physical findings of the acyanotic congenital heart defects		
29.	Correlate history and physical findings of the cyanotic congenital heart defects		
30.	Identify pallative and corrective surgical procedures in congenital anomalies		
31.	Assessment skills needed to handle patients and families who are in an acute state		
32.	Diagnostic skills needed to assess patients for pathology and give preliminary interpretations		
33.	Technical skills in performing echocardiography with accuracy to allow the physician to form a diagnosis		
34.	Communication skills when dealing with peers		

Item		A	B
35.	Advocacy/political skills in following the institution's regulations and rules		
36.	Organizational/management skills of accomplishing the daily tasks/tests ordered		
37.	Collaboration skills when dealing with fellow technicians and physicians		
38.	Understanding of self-personal values, beliefs and attitudes		
39.	Understanding the nature of human values and the development of a personal philosophy		
40.	Self-directed learning skills		
41.	Comprehension of the meaning of spirituality as it relates to health		
42.	Research interpretation skills if appropriate to the institution		

On the back of this form, please indicate if you have experienced any specific problems with the "professional skills" of the ComTech graduates.

APPENDIX C
EMPLOYER QUESTIONNAIRE

Dear Employer,

May 30, 1991

The University of Toledo Community and Technical College is asking for your assistance in conducting an employment needs study regarding graduates of the Cardiovascular Technology Program. According to our records, your institution has employed a number of graduates from our program.

The purpose of this survey is to learn about employers views concerning graduates of the ComTech Cardiovascular Technology Program from 1986 to the present. We expect to use the findings from this survey to improve the quality of the program and services to our students. Therefore your answers and responses are invaluable to our program.

The information you provide for this survey will be used only for purposes of program planning and evaluation. All information is confidential and your identity will not be revealed. Data have been coded to track the returned surveys. A master list will be kept with the principle investigator, and it will be disposed of after the results are compiled. The survey should take no longer than 20 minutes to complete.

Your participation is voluntary and will not affect your relations to the University of Toledo. A completed returned survey is considered consent to participate in the project.

Thank you in advance for your time and assistance. Please return the completed survey in the self-addressed, stamped envelope provided by June 15, 1991. If you have any questions about the survey, please phone me at 537-3112. I will be happy to discuss any concerns you may have.

Sincerely,

Sue Wambold, Director
Cardiovascular Technology

Survey of Employers/Supervisors of Graduates

PART I: Background Information

If you HAVE NOT employed any Cardiovascular Technology associate degree graduates, please DO NOT complete this survey, but return it in the enclosed envèlope.

If you have employed any Cardiovascular Technology associate degree graduates please proceed with this survey.

A. HIRING INFORMATION

	1986-1989		1990-present	
	Full-time	Part-time	Full-time	Part-time
a. TOTAL NUMBER HIRED				
b. ComTech graduates				
c. Mary Grove College graduates				
d. Cuyahoga Community College graduates				
e. Others (please identify other institutions)				

1. What is the estimated beginning annual salary range for this job title/classification of Cardiovascular Technologist. Please include a brief job description when you return this survey.

a. Job Title _____
b. Hourly salary: $ _____

2. Is this commonly a part time or full time position?
a. _____Part time b. _____Full time

3. Are there benefits with part time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

4. Are there benefits with full time employment? If yes, please indicate which ones.

_____ No
_____ Yes
_____ a. Medical benefits
_____ b. Dental benefits
_____ c. Vision
_____ d. Child care
_____ e. Sick leave
_____ f. Vacation
_____ g. Tuition reimbursement for credit courses
_____ h. Reimbursement for seminars

If you did not hire a ComTech graduate, you may STOP here and return the survey in the enclosed envelope. Thank You.

If you have hired a ComTech graduate from 1986 to the present, please continue with section B. Thank You.

B. EMPLOYMENT CHANGES

	1986-1989		1990-present	
ComTech graduates ONLY	Full-time	Part-time	Full-time	Part-time
a. Left Voluntarily				
1. Full time employment				
2. Part time employment				
3. Position with increased responsibility				
4. Relocated for personal reasons				
5. Is no longer employed				

b. Left Involuntarily				
1. Terminated due to financial constraints of the institution				
2. Terminated for professional incompetence				
3. Terminated for personal conduct				

Part II: Program Effectiveness

Directions: Please rate the competency of the 1986-1991 graduates of the ComTech Cardiovascular Technology program in relation to each of the following professional practice skills and testing modalities using the following scale.

In **Column A:** In general how often does the ComTech cardiovascular technologist perform these tasks.

Scale: 1= Not at All 2=Not Often 3=Often 4=Very Often

In **Column B:** In general how well prepared are the ComTech cardiovascular technologists for these tasks.

Scale: 1=Poor 2=Fair 3=Good 4=Excellent 5=NA

		COLUMN	
Item		**A**	**B**
1.	Basic physical principles of ultrasound and instrumentation		
2.	Proper use of gain and depth control		
3.	Proper transducer selection		
4.	Explanation of the principles of Doppler ultrasound		
5.	Techniques used in determining blood flow velocity profiles and characteristics (Bernoulli's equation, CW and PW)		
6.	Imaging of color flow mapping		
7.	Demonstrate an understanding of patient care		
8.	Explain and instruct procedures to patients		
9.	Obtain a blood pressure measurement prior to an echo		
10.	Explain the mechanism of action and indications for common cardiac medications		
11.	Perform an M-mode echo with structure measurements		
12.	Perform a two-dimensional echo with inspection of the heart from all views, and identification of the structures in each view		
13.	Accurately measure the fractional area change and fractional shortening		

Item		A	B
14.	Accurately measure the mitral valve orifice area		
15.	Compare the EKG infarct pattern with the wall motion abnormalities		
16.	Accurately calculate an ejection fraction		
17.	Perform pulsed wave doppler on all four cardiac valves		
18.	Perform continuous wave doppler on all four cardiac valves		
19.	Explain the fundamentals of color flow imaging for assessment of pathology		
20.	Assess valvular gradients with Doppler		
21.	Calculate the aortic valve area with use of CW and PW		
22.	Calculate pressure half-time of the mitral valve		
23.	Indicate pathology to be identified with diseases of the heart valves (insufficiency and stenosis)		
24.	Indicate the pathology to be identified with pericardial disease		
25.	Indicate the pathology to be identified with the cardiomyopathies		
26.	Explain wall motion score index in relationship to coronary artery disease		
27.	Explain the views utilized for assessment of congenital heart disease		
28.	Correlate history and physical findings of the acyanotic congenital heart defects		
29.	Correlate history and physical findings of the cyanotic congenital heart defects		
30.	Identify pallative and corrective surgical procedures in congenital anomalies		
31.	Assessment skills needed to handle patients and families who are in an acute state		
32.	Diagnostic skills needed to assess patients for pathology and give preliminary interpretations		
33.	Technical skills in performing echocardiography with accuracy to allow the physician to form a diagnosis		
34.	Communication skills when dealing with peers		

Item		A	B
35.	Advocacy/political skills in following the institution's regulations and rules		
36.	Organizational/management skills of accomplishing the daily tasks/tests ordered		
37.	Collaboration skills when dealing with fellow technicians and physicians		
38.	Understanding of self-personal values, beliefs and attitudes		
39.	Understanding the nature of human values and the development of a personal philosophy		
40.	Self-directed learning skills		
41.	Comprehension of the meaning of spirituality as it relates to health		
42.	Research interpretation skills if appropriate to the institution		

On the back of this form, please indicate if you have experienced any specific problems with the "professional skills" of the ComTech graduates.

Part III: Future Plans

3. Summary of estimated job openings:

Job openings (estimate)	New Positions	Turnover Positions	Total Positions
Year 1990			
Full-time openings			
Part-time openings			
On-Call positions			
Year 1991			
Full-time openings			
Part-time openings			
On-Call positions			
Year 1992			
Full-time openings			
Part-time openings			
On-Call positions			

APPENDIX D
SECOND APPEAL LETTER

June 20, 1991

Dear Cardiovascular Technology Alumni/Employer,

On May 30, 1991 you were mailed a questionnaire regarding the cardiovascular curriculum at The University of Toledo Community and Technical College. Many participants have returned their questionnaire as requested. It is very important that all others do so as well. In the event you have misplaced the questionnaire, please call me so that I may mail you another. I am available during the day at 419-537-3112.

If you have already mailed in your responses, please ignore this second appeal and accept my thanks for your assistance.

Sincerely,

Sue Wambold, Director
Cardiovascular Technology Program

APPENDIX E
COMMENTS

The following is a random listing of the comments included on the back page of the returned surveys. These comments were provided by nineteen of the the 1986-1989 alumni respondents. No comments were listed by the employers or alumni of 1990, nor by the student group.

1. Felt inadequately prepared to apply for a cardiovascular job.
2. Felt there was adequate theory provided, but no on-site lab "hands on" time.
3. Poorly organized physics class. The physics did not appear appropriate for the cardiovascular students.
4. Poorly set up program, especially the ultrasound physics. The physics was geared for the respiratory students.
5. Poor lab facilities at school. Did not feel prepared for a job.
6. Poor clinical rotation. Did not get checked off at the site based upon the objectives.
7. There is a difference in the recent graduates training compared to those of us who graduated 4 and 5 years ago.
8. Grateful for getting training at the institution now employed with.
9. Good idea to do a survey. It shows concern for the graduates. There needs to be an increase in quality clinical hours.
10. Too many equipment limitation at school.
11. Due to changing technology, need to address Transesophageal Echocardiography (TEE) in the curriculum.
12. Did not feel prepared to perform cardiovascular duties.
13. A need for more hands on time.
14. A need for more clinical hours.
15. Need to incorporate more congenital anomalies and repair. Even though there are few pediatric hospitals, these children will be the adults we will scan soon.
16. Felt disgusted, left the program unprepared. Poor labs, and lousy clinical rotation. Wished they would have went to become an RN. Is now pursuing a nursing degree.
17. Got the book knowledge, but not the hands on skill.
18. Poor knobology and physics classes.
19. Felt unprepared for a job and the registry.

APPENDIX F
PROGRAM EFFECTIVENESS AREAS OF COMPETENCE

Both alumni groups and employers were asked how frequently forty-two areas of competence were used at their work sites. The following is a listing of the modalities included:

1. Basic physical principles of ultrasound and instrumentation
2. Proper use of gain and depth control
3. Proper transducer selection
4. Explanation of the principles of Doppler ultrasound
5. Techniques used in determining blood flow velocity profiles and characteristics (Bernoulli's equation, CW and PW)
6. Imaging of color flow mapping
7. Demonstrate an understanding of patient care
8. Explain and instruct procedures to patients
9. Obtain a blood pressure measurement prior to an echo
10. Explain the mechanism of action and indications for common cardiac medications
11. Perform an M-mode echo with structure measurements
12. Perform a two-dimensional echo with inspection of the heart from all views, and identification of the structures in each view
13. Accurately measure the fractional area change and fractional shortening
14. Accurately measure the mitral valve orifice area
15. Compare the EKG infarct pattern with the wall motion abnormalities
16. Accurately calculate an ejection fraction
17. Perform pulsed wave Doppler on all four cardiac valves
18. Perform continuous wave Doppler on all four cardiac valves
19. Explain the fundamentals of color flow imaging for assessment of pathology
20. Assess valvular gradients with Doppler
21. Calculate the aortic valve area with use of CW and PW
22. Calculate pressure half-time of the mitral valve
23. Indicate pathology to be identified with diseases of the heart valves (insufficiency and stenosis)
24. Indicate the pathology to be identified with pericardial disease
25. Indicate the pathology to be identified with the cardiomyopathies
26. Explain wall motion score index in relationship to coronary artery disease
27. Explain the views utilized for assessment of congenital heart disease
28. Correlate history and physical findings of the acyanotic congenital heart defect
29. Correlate history and physical findings of the cyanotic congenital heart defects
30. Identify pallative and corrective surgical procedures in congenital anomalies

31. Assessment skills needed to handle patients and families who are in an acute state
32. Diagnostic skills needed to assess patients for pathology and give preliminary interpretations
33. Technical skills in performing echocardiography with accuracy to allow the physician to form a diagnosis
34. Communication skills when dealing with peers
35. Advocacy/political skills in following the institution's regulations and rules
36. Organizational/management skills of accomplishing the daily tasks/tests ordered
37. Collaboration skills when dealing with fellow technicians and physicians
38. Understanding of self-personal values, beliefs and attitudes
39. Understanding the nature of human values and the development of a personal philosophy
40. Self-directed learning skills
41. Comprehension of the meaning of spirituality as it relates to health
42. Research interpretation skills if appropriate to the institution.

REFERENCES

Anerican Medical Association: Essentials of an approved program for the cardiovascualr therapy technician. Chicago, Council on Allied Health Education, 1977.

Andrew, B. J. (1972). Measuring changes in clinical performance. Proceedings of the regional medical programs national conference and workshop on evaluation. Washington: Department of Health Education and Welfare. Public Health Services pg. 55-59.

Babbie, E. R. (1990). Survey research methods. Belmont, California. Wadsworth Publishing Company Inc.

Bloom, B. S. (1969). Learning for Mastery. Published in UCLA Education Comment. CSEIP May, Volume 1, No. 2.

Bloom, B. S. (1976). Human characteristics and school learning. New York: McGraw Hill.

Bowman, B. (1985). Needs assessment: An information processing model. Journal of Continuing Education of Nursing. Nov/Dec., Vol. 16, #6, pg. 200-204.

Brandt, R. (1988). Content of the curriculum. 1988 ASCD yearbook of the Association for Supervision and Curriculum Development, pg. 75-90.

Brady, L. (1986). Models for curriculum development: The theory and practice. Curriculum and Teaching, Vol. #1, No. 1&2.

Carroll, J. (1963). A model of school learning. Teachers College Record. Vol. 64: 723-733.

Cox, W. and Dunn T. (1979). Mastery learning: A psychological trap? Educational Psychologist, Vol. 14, pg. 24-29.

Diamond, R. M. (1989). Designing and improving courses and curricula in higher education: a systematic approach. San Francisco, California: Jossey-Bass Inc., Publishers.

Gagne, R. M., and Briggs, L. J. (1974). Principles of instructional design. New York: Holt, Rinehart and Winston.

Glaser, R. (1968). Adapting the elementary curriculum to individual performance. Proceedings of the 1967 Invitational Conference on Testing Problems. Princeton, New Jersey: Educational Testing Service, 1968.

Goodlad, J. and Anderson R. (1959). The nongraded elementary school. New York: Harcourt, Brace and World.

Knox, A. B. (1977). Adult development and learning. San Francisco, California: Jossey-Bass.

Morrison, H. (1926). The practice of teaching in the secondary school. Chicago: University of Chicago Press.

Patton, F. D. (1980). The third dimension: The future of educational technology in industry. Journal of Instructional Development, Vol. 3. pg. 25-27.

Ponza, K. (1976). A demonstration model for needs analysis utilizing the professional activity study and a questionnaire for nurses in region II of Indiana. (Report No. SE 196 54). Goshen College, Indiana; Indiana University. South Bend. (ERIC Document Reproduction Service No. ED 123047).

Salvia, J. and Hughes, C. (1990). Curriculum based assessment testing: What is taught. New York: Macmillan Publishing Company.

Skinner, B. V. (1954). The science of learning and the art of teaching. Harvard Educational Review. Vol. 24, pg. 86-97.

Suppes, P. (1966). The uses of computers in education. Scientific American. Vol. 2, pg. 206-215.

Walker, N. (1983). Performance outcomes and performance standards for selected occupational programs. (Report No. JC 820 343). Florida State Department of Education, Tallahassee. Division of Community Colleges; Florida State Department of Education, Tallahassee. Division of Vocational Education; Pensacola Junior College, Florida. (ERIC Document Reproduction Service No. ED 220119).

Wallington, C. J. (1980). We live in two different worlds: A reaction to Patton's article. Journal of Instructional Development, Vol. 3, pg. 28-29.

Woods, N.F. (1988). Analyzing existing knowledge. In N.F. Woods and M. Catanzaro, Nursing Research: Theory and practice (pp. 46-65). St. Louis: Mosby.

ERIC Clearinghouse for Junior Colleges DEC 06 1991